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WOODEN PAVEMENTS.

The history of this method of paving in wood is short and full of interest. Since the introduction of this practice we have carefully noticed every experiment of importance and have not done so without coming to certain conclusions of a practical bearing upon future trials.

In the first place, we believe it is pretty generally known that the method of paving in wood had its origin in Russia. The most approved mode of proceeding is to fasten together by wooden pins, hexagonal blocks of wood placed with the fibres in a vertical direction. From all that we can learn, the practice in this or a similar form has considerable antiquity, but from the high price of timber and the disadvantages attendant upon the earlier and more clumsy modes of construction, no one ever appears to have entertained the idea of introducing wooden pavements into western Europe, or even into the United States, until within the last six or seven years.

Somewhere about the latter part of 1833 or the commencement of 1834, a Russian gentleman, as we are informed, suggested the propriety of making some experiments in wooden paving to our city authorities. We greatly regret that we cannot ascertain the name of this public spirited individual who, without any emolument to himself, kindly volunteered all the information necessary for commencing the experiment. The specifications were prepared by the street commissioner, Mr. George B. Smith, who also gave his attention during the construction and thus secured a fair trial.

The spot selected for the experiment was in Broadway a few yards south of Chamber-street, and one about as well adapted for a severe test as any to be found in New York or elsewhere. When the old pavement was removed a densely compacted mass of sand and gravel, caused by years of enormous travel, was found, which required the pick and crow bar to remove it. The excavation was continued to the depth of 18 inches or two feet, which left the ordinary gravel and sand of our city exposed. Upon

this, three different foundations were laid for wooden blocks. In one place an ordinary pavement of round stones was laid; in another broken flag stones about four inches thick, were used, and in the third, broken stones were laid somewhat after the fashion of a McAdam, road one foot deep. These three foundations were so arranged as to give one unbroken surface one foot beneath the intended level of the street.

The blocks used were hexagonal prisms one foot long, and cut from a cylinder 9 inches in diameter; they were of hemlock, seasoned, but without any preparation by Kyanizing or any similar process. They were fitted into their places as closely as possible and wedged tightly between a curb on the two sides. Over the pavement thus neatly and accurately finished, hot tar was poured and over this, before it cooled, gravel was sprinkled.

The smooth and beautiful appearance of this pavement attracted general attention, while the change to the passengers in omnibuses, from the dreadful jolting to the easy and rapid passage over the wood, and back again to the jolt, never failed to elicit a wish that all Broadway was paved in a similar manner. Inquiries began to pour in from all directions, as to the mode of construction, and it was found necessary to keep on hand in the office of the street commissioner, copies of the description. In this way the experiment was soon got up in Philadelphia, Charlestown, Toronto, and in fact, nearly all our large cities and in Canada.

About 18 months after the pavement was laid, one or two blocks were found to be slightly depressed. On examination they proved to be affected with dry rot, and from the appearance of the tar on their surface, as compared with that on the sound ones, the impression was derived that this rot had commenced *previous* to their being laid.

The pavement has now been used *six years* in one of the most frequented parts of our city, and is yet, not only good, but better than any other in the city, except those of the same kind. No difference can even now be detected between the portions having different foundations, and this we attribute to the manner of wedging the whole breadth of the street, which, in a great measure, obviated the necessity for any other foundation. It is greatly to be regretted that a part was not laid directly upon the sand and also that some preservative process was not used. In that case we should have had six years experience more than we now have.

Since 1834, several trials have been made, and within the last year or two, satisfied of the excellence of the plan, a number of pieces have been laid by individuals of different neighborhoods to the amount of one mile or more. Some of the earlier of these trials were made with square or rectangular prisims, and in some the blocks were laid upon plank as a foundation.

The mode at present most extensively adopted consists in the use of blocks not more than six or eight inches deep and 12 to 18 in diameter, and these are laid directly upon the sand and gravel constituting the foundation of our city.

The chief, and in fact, the only valid objection to the general introduction of wooden pavements, is the greater cost than for common stone pavements, but in estimating this we must not only take into consideration the prime cost, but also the durability of the wood. In this view of the case we consider it to be mistaken economy either to do the work hastily or to omit some preservative process. Decidedly the best foundation is good even gravel or sand, and this has also the advantage of being cheapest. Whatever form of block or of foundation is employed, the greatest care should be used in fitting them into perfect contact, by which means the entrance of water and of decomposible matter, is nearly prevented. Some means of preserving the wood should always be adopted, for there is no doubt that the ordinary period of decay, may, by such means, be almost indefinitely protracted.

The use of hot tar, as in the first experiment, is a simple and useful, although superficial remedy. Kyanising is too costly, but there are other methods quite as effectual and much cheaper.

Of the superior comfort and cheapness of this mods of paving in great thoroughfares, there is no longer any doubt. In the first trial in Broadway, the wooden pavement has remained untouched, except where opened, rather for examination than otherwise. Its cost for repairs has therefore been nearly nothing, while the common stone pavement immediately adjoining has been extensively repaired several times and parts of it, if we mistake not, relaid. It is always less muddy and dries sooner than any other part of the street, and in all other respects is equally superior. But we are told that in retired streets, a stone pavement ought to last twenty years, whereas a wooden pavement will not endure half that time without decay. To be sure under such circumstances stone *ought* to last twenty years—but does it, and as long as it lasts what is it? As to the limit of the durability of wood, we are inclined to doubt of its accuracy.

After all, the great bar is the prejudice against any thing new, which in this case operates to a greater degree than most are willing to admit. The subject appears to have become quite notorious in England and rival patents have been taken out, even for the angle and inclination of the grain of the wood from a perpendicular.

Besides ordinary streets, there are many other localities peculiarly appropriate to the use of wood. On account of its lightness, it has been preferred as a roadway for suspension bridges. Its exemption from noise and dust, while advantageous every where, is particularly so in the vicinity of churches, court houses, schools, hospitals, dwellings, and where delicate articles are sold. Its peculiar surface renders it an admirable substitute for flag stones, particularly where horses are obliged to cross, as in these situations it forms an equal if not superior footway, and does not cause the horses to slip and stumble as do flags. This quality has also recommended it as a paving where horses are used on railroads, particularly in cities, either when turning short curves or ascending steep grades. The facility with

which rails can be laid on this kind of foundation is another reason for using it more frequently, and in certain situations we are not certain that it would not be the best mode of laying rails. The opportunity for introducing this modern comfort and luxury of all who go through cities in their own or others vehicles, are so numerous as to ensure its general adoption. But meanwhile we must caution all interested in the matter from taking alarm at the speedy decay which must shortly overtake all these pavements which have been laid in a hasty or careless manner.

ANOTHER TRIUMPH OF STEAM.—The steam packet Acadia, has performed her last trip in 231 hours (9 days 15 hours) from raising her anchor at Halifax, to droping it in Liverpool harbor.

To the Editors of the American Railroad Journal and Mechanics' Magazine.

If you think that the following communication on the subject of lattice bridges would be useful to your readers, you are at liberty to insert it in your Journal.

Among the great variety of bridge plans that have from time to time been presented to the American public, none have received a more flattering reception than the lattice arrangement of Mr. Town; its beautiful simplicity, light appearance, and especially its economy, have secured for it the favor of many of our most eminent engineers and builders, as is evident from the extent to which it has been adopted on works of the greatest magnitude and importance.

On ordinary roads, and on railways not subjected to very heavy transportations, this plan of superstructure, when well constructed, has been found to possess almost every desideratum, but experience has fully proved that unless strengthened by additional arch braces or arches, the capacity of the structure is limited to light loads and spans of small extent.

The public works of Pennsylvania furnish abundant proof of the truth of this assertion, and several railways might be enumerated on which the lattice bridges have from necessity been strengthened by props from the ground by arches, or by braces added when the insufficiency of the structure was found to require it.

These defects are producing a change in opinion hostile to the whole plan, and it is much to be regreted that instead of attempting such modifications and improvements as would remedy existing defects and retain its advantages, other plans are introduced at an expense frequently more than double that of an efficient lattice structure.

Improvements of this kind have been attempted, and are now offered to the profession; a description of them will follow after a brief examination of the apparent defects of the ordinary lattice, and of the general principles on which the alleged improvements are founded.

One of the first defects apparent in many lattice bridges is the warped condition of the side trusses. The cause which produces this effect cannot, perhaps, be better explained than by comparing them to a narrow and

deep board placed edgewise on two supporters, and loaded with a heavy weight; so long as a sufficient lateral support is furnished the strength may be found sufficient, but when the lateral support is removed the board twists and falls. A lattice truss is composed of thin plank, and its construction in every respect such as to render this illustration appropriate. Perhaps the action referred to could be prevented by bolting the cross ties to the chords in addition to the usual plan of notching, and by introducing a complete system of transverse diagonal bracing, but the mode recommended in the improved plan is, it is believed, much more simple, effectual, and economical.

A second defect is found in the inclined position of the tie. All bridge trusses, whatever may be their particular construction, are composed of three series of timbers, which may be considered as the indispensible elements: these are ties or uprights, braces, and straight or curved longitudinial pieces, known under the name of chords, arches, caps, ties, &c. In every plan except the lattice, the ties are either vertical or perpendicular, or nearly so, to the chords or arches, and as the force transmitted by any brace is naturally resolved into two components—one in the direction of the chord, the other perpendicular to it; this latter force could be best resisted by a tie, the direction of which was also perpendicular.

Experience has proved that the ends of the ties in lattice bridges have a great tendency to split, which can be accounted for from the circumstance that their inclined position subjects them to an angular motion, and consequently a cross strain upon the pins whenever the bridge settles. The short ties and braces at the extremities, furnishing but an insecure support, render those points which sustain the greatest weight weaker than all others; this defect is removed by extending the truss over the edge of the abutments a distance equal to its height, the effect of which is to provide a remedy at the expense of economy, by the introduction of from 15 to 30 feet of additional truss, requiring a corresponding increase in the depths of the recesses and thickness of abutments.

It is believed that the truth of the following propositions forming the basis of some proposed improvement, and which are susceptible of easy demonstration, no one who has attentively observed the action of the parts in systems of bridge frames will be disposed to question.

1st. The forces of compression on the upper, and the extension on the lower chords of a straight bridge are equal, and increase from the ends to the centre where they attain a maximum.

2nd. The vertical weight on the ties and braces increases from the centre to the ends, and in straight bridges uniformly loaded, is double as great at the latter as at the former points.

As a consequence of these propositions it follows, that a bridge whose corresponding timbers in all its parts are of the same size is badly proportioned, that some parts must be unnecessarily strong or others too weak, and that a useless profusion of material must be allowed, or the structure will be insufficient.

If, for example, the forces acting on the chords increase constantly from the ends to the centre, the most scientific mode of compensation would be to increase proportionally the thickness of the chords, and to include the principle involved in the second proposition, the ties and braces should increase in an inverse order from the centre to the ends.

These methods, requiring a variation in the size of every timber, would of course be inconvenient and expensive, but as the principles are of great importance, such other arrangements should be adopted as will secure their advantages and at the same time possess sufficient simplicity for practice.

These desirable objects are attained by the introduction of arch braces, than which a more simple and efficacious mode of strengthening a bridge could not be adopted, as they not only serve to relieve the chords, but transmit directly to the abutments a great part of the weight that would otherwise be thrown upon the ties and braces

As all the bridges in common use are composed of the uniform timbers already described, it follows that arches or arch braces are, for the reasons assigned, essential to them all, and it is gratifying to perceive that eminent professional men have noticed their importance and that the introduction of them is becoming general.

It may be objected that the pressure of the arch braces would injure the abutment against which they are placed, in answer to which it may be remarked that a certain degree of pressure is very proper and necessary. The embankment behind an abutment exerts a very great force upon it, the tendency of which is to push it forward; if then a counter pressure can be produced by the thrust of arch braces or by wedging the lower chords, two important advantages are gained; the abutment is not only increased in strength, but the tension on the lower chords of the bridge is diminished to an amount equal to the degree of pressure thus produced.

It is, however, proper to observe that when the situation of the embankment exposes it to the danger of being washee away from the back of an abutment, the pressure on its face should not be sufficient to destroy its equilibrium; if there is danger of this effect, additional horizontal ties may be introduced.

An essential condition in every good bridge is that it shall not only be sufficient to resist the greatest weight to which it can be subjected, but it must also be secure against the effects of variable loads; this is generally effected by the addition of counter braces, but the lattice truss possesses this peculiarity, that it is effectually counter braced without the addition of pieces designed as in Long's bridges, exclusively for this purpose; to prove this, insert the truss where it will be apparent that the braces become ties and the ties braces, possessing the same strength in both positions.

The foregoing remarks will enable the reader to understand the objects of the proposed improvements and the principles on which they are founded. (*See Figure.*)

1st. The braces, instead of being single as in the common lattice, are in

pairs, one in each side of the truss, between which a vertical tie passes, (fig. 2.) This arrangement increases the stiffness on the same principle that a hollow cylinder is more stiff than a solid one with the same quantity of material, and of the same length, and obviates the first defect of warping.

H. Haupt's Improved Lattice Bridges.

Fig. 1.

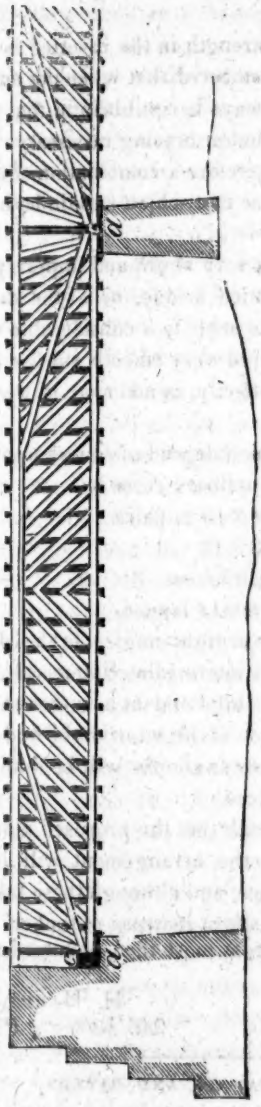


Fig. 3.

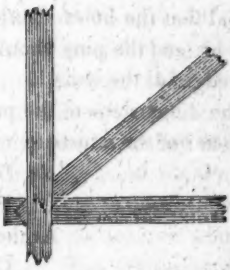


Fig. 2.

2nd. The tie is vertical, a position which is more natural, and in which it is more efficacious than when inclined.

3d. The end braces all rest on, and radiate from, the end of the abut-

ment, (*a*, fig. 1,) by which means a firm support is given to the structure, and the truss is not required of greater length than is sufficient to give the braces room.

4th. By inverting the truss it will be seen that it is effectually counter braced, the ties becoming braces and the braces inclined ties, capable of opposing a resistance on the principle of the inclined tie of the ordinary lattice, (fig. 3.)

It is readily admitted, that the strength in the inverted is less than in the erect position, but it must be remembered that when not subjected to more than its own weight, a bridge is always in equilibrium, that the peculiar action of the parts which renders counter bracing necessary results entirely from the variable load, and that therefore a combination of timbers to resist its effects, should not be as strong as that which sustain both the permanent and variable loads.

As it can be demonstrated that a very slight and imperceptible degree of compression at the pins of any lattice bridge, or at the shoulders of any brace bridge will allow the truss to settle to a considerable extent, it is essential that the holes should be bored very smooth similar to those made by a bit, and the pins should fit perfectly, in addition to which, they may be wedged at the ends.

The dimensions of the parts, which depend of course upon the size and character of the structure, may for ordinary cases be,

Braces, 2×10 in pairs.
Pins, 3×12
Arches or arch braces, 6×12.
Chords, 3×14 lapped.

Pins 2¼ in diameter, placed in line at right angles to the direction of the brace; 3 at the chords, and 2 at the intermediate intersections, (fig. 3.)

A wall plate should be placed behind and at a sufficient distance from the ends of the lower chords to allow of the insertion of wedges, (C. C.) by driving which the tension on the lower chords will be diminished by an amount equal to the pressure produced.

In conclusion it is proper to remark that the proposed plan is more economical than any in general use; the arrangement will be found even more simple than the ordinary lattice, and although these braces, in consequence of being in pairs, require a slight increase of timber, yet the diminished length of the ties and of the truss more than counter-balance this increase.

H. Haupt, C. E.
246 *Race-st., Philadelphia.*

RAILROADS V. CANALS AND RIVERS.

Extract from the report of of J. Edgar Thompson, chief engineer, to the directors of the Georgia railroad and banking company.

"*I can now state with confidence, that wherever the transportation is of a mixed character, such as agricultural products,* GENERAL MERCHAN-

DIZE, *and passengers sufficiently large, to justify the construction of a* GOOD ROAD, *railways will be found to be not only the most expeditious,* BUT THE CHEAPEST ARTIFICIAL MEDIUM OF CONVEYANCE AT PRESENT, KNOWN."

We give the foregoing extract from the report, and *experience* of a highly respectable engineer, in as much as we are gratified to find that light is beginning to develope itself, as to the capacity of railways, for general transportation.

The adaptation of steam to the improved locomotive, to draw immense loads over *iron ribed roads* at cheap rates, is destined to work as complete a change in our *inland forwarding business,* as the application of steam to propel boats against wind and currents, on rivers and the ocean. Steam and railroads will be the best bank to regulate our exchanges.

We may be sanguine in our view, and in advance of, and shock the prejudices of many, when we assert our conviction, that railways *are destined to supercede rivers and canals, in the transportation of valuable merchandize,* freight and passengers. The consumer will advocate them, and all must submit to the march of this better improvement of the day.

Our eastern neighbors, with their usual sagacity, must have arrived at this conclusion, or they would not have ventured on the expenditure of $6,500,000, to construct a railway from Boston to Albany to intercept our western trade. We would here renew the remark, made on a former occasion, that the three canals first constructed in New England, viz. the Middlesex, the Blackstone, and the Farmington, have been superceded by railways. The Camden and Amboy railroad, takes the income from the sluggish Delaware and Raritan Canal. The Philadelphia, Wilmington and Baltimore railroad is superceding the steamboats on the Delaware and the Chesepeake. It does not require a prophet to predict, that the Chesapeake and Ohio canal, will prove a perfect failure, compared with the Baltimore and Ohio railroad. We would desire to touch lightly on the losses of the stockholders in the Schuylkill canal, on even the prospect of the competition with the Philadelphia, Reading and Pottsville railroad. Suffice it to say, that the canal stock, which was $380 per $100, paid, prior to the commencement of the railroad, has fallen to $150 per $100, since it has been shown by actual experiment, that one locomotive has drawn 423 nett tons from Reading to Philadelphia, 54½ miles, in five hours, at the trifling cost of $57, all expenses included, for fuel, oil, engineers, and 4 men at the breaks. This sum also includes, $20 allowed for the use of the 101 cars on which this enormous load was conveyed.

☞With these facts before us, *should we not pause, and examine into our canal policy?* We ask the west to reflect on this subject, ere we are too deep in debt for railroads. J. E. B.

We have received the following reply to the communication of Mr. Aycrigg. We must remark that the article appears to have been rather

hastily written and contains expressions which the author himself would not perhaps wish to see in print a year hence,—a regard for all parties has therefore induced us to suppress all parts of the communication not bearing directly upon the question, as well as such epithets and expletives as courtesy would require to be omitted.

For the American Railroad Journal and Mechanics' Magazine.

GENTLEMEN—There would be no occasion for a rejoinder to such a communication as the last by Mr. B. Aycrigg, except from the numerous errors which it contains. These, however, they originate, demand of me at least the trouble of a brief notice.

If, then, he will turn to my first communication upon this subject, (R. R. J. vol. iv p. 241) published *before* Mr. B. A. wrote upon the subject, he will perceive why I was particularly called upon," etc. My reasons are contained in the very first sentence, and their substance is because those theories were *applied to explain the errors of de Pambour's formula*, the causes of which I had already, long previously assigned as well as expressed in magnitude, by general expressions, applicable to all cases of practice, and agreeing perfectly therewith. (R. R. J. vol.—) Is he answered? Did it require permission to do this?

I may, however, be allowed to ask, what Mr. B. A. has to *do with this part of the subject at all.* since the expression he quotes, obviously refers to *ideas promulgated by others*, some time previous to his having aught to do with the question—in his his own words, "Why does he suppose himself the object of attack when no one but himself has referred to him?"

Is he not as unfortunate in taking upon himself my remark about "an absurd estimate of the actual loss," since he does not venture to make *any estimate at all of the amount of the loss*, or to bring his theory to any practical conclusion. He is challenged to produce an expression of this, applicable to practice.

As to his expression of the amount of power lodged in the connecting rod at any particular point of the revolution, viz. $p=P$ sec. d, and which was deemed a "profound absurdity." I would ask if, (taking the same case of a short rod for the sake of making the thing obvious) the secant of 90° is not *infinite?* and if when in that position, or near it, the force in the rod, viz. p would not "exceed P the *force upon the piston to an infinite degree?*" I would inquire if this is not manifestly absurd, and does not lead inevitably to the conclusion I have attributed to it, and if P. be put for but the power of an insect, for instance, whether P sec. d would not represent, in all strictness, an unlimited accumulation of force, and that too, *created*, simply by directing the rod more and more from the original diverting of the power?

Presuming interrogatories of this description to be entirely within the parliamentary rules, I would also inquire if at this very point, the force in the rod, instead of being very great and even unlimited, would not, agreeably to the principles of mechanics, be just nothing at all? No illustration can

make white black; but as to the illustration of a rafter, I would ask him if there is really no distinction in things? If the force of gravity, always acting vertically through the centre of gravity of the rafter or voussoir of an arch, would cause a thrust in the length of the rafter, at all analogous to that of a motive force acting *upon its end at* the point of support? And whether that motive force could possibly cause any more than equal thrust along the rafter, *even when* its direction coincided; and whether it must not be proportionately *less*, along the rafter in proportion as the *angle* its direction makes with the rafter is *increased*, till, when at right angles to it, the thrust along the rafter becomes zero, instead of the infinite one the expression implies. Is it not clear then that, as this *assumption* is the basis of all Mr. B. A. has said or done, that his whole superstructure necessarily falls with it? And will it not be time enough to disprove his details when he shall have established a foundation for them to rest upon? And can not he perceive in this too, why I simply adduced the proportion V : *v* : : sin *c* : R without further comment, or 'tilt' upon minor *points d' appui*, than to call attention to it, "as a matter which would equally overthrow his whole fabric." And has not its fallacy *since been exhibited* and by one too, whom he says, "has always thought with himself?"

Furthermore, I would ask him, if a train of cars, for instance, were to be *pushed* up an inclined plane by a power acting horizontally, a greater power would not be required in proportion to the inclinations of the plane, to force up the same train? or, in other words, whether if the power should remain constant like that upon the piston, the load would not have to be reduced? Not certainly that the load might be increased as the plane 'becomes steeper!' Is not this a perfect analogy—this uniform horizontal power representing that of the piston and the proportion of it effective up or along the plane, the effect it is capable of producing in that direction. Instead of the usual plan of railroads, if this theory of Mr. B. A. were true, *perpendicular roads* must entirely supercede them.

Again, I would inquire if, because I showed that that portion of the resistance to locomotion upon railroads which was usually designated "friction," was, "indeed, a compound result, including within it the effect of the crank," there is any reason or fairness in assuming me to have said that "the friction of the crank itself is the only loss in effect from crank motion?" Is there any thing in my language inconsistent with the fact that the loss in effect from crank motion is at least, almost entirely caused by loss of leverage in transforming the motion out of its original direction into the circular one of the crank, by means of the necessary gearing suitable to the purpose? It is not true therefore that I have in any way "yielded the point in dispute, or granted that there is no loss from the crank except extra friction," nor that I have in any way compromised a position that I have taken.

Mr. B. A. is challenged to produce his "practical demonstration" of an

expression of the powers of locomotives, which after tabulating and "combining several operations," "still require upwards of 30 distinct calculations." By the way, I would here inquire, why he applies my remark of "mere assertion," etc. in any way in connection with this expression? since the clause to which it *did refer*, was quoted entire and specifically.

Mr. B. A. insinuates that every argument I have used is untenable. Alas! for having been compelled in self-defence, to demolish a glass house! But is this the philosophy of "Newton." But no matter, I must rest satisfied that *they*, at *least*, do *agree* with, *and explain perfectly the results of practice*, and that I regard as a far higher commendation than even an agreement with any absurd and groundless opinions whatever. For my part I can see no difference between a mathematician and an astrologer, when the former deals only in signs without meaning or as representatives of things existing only in the imagination. The symbols of Newton represented real things, and he reasoned with them accordingly.

WM. MCC. CUSHMAN, C. E.

Albany, Sept. 7.

DEPOTS AND GROUND FOR RAILWAYS.

Few railroad companies, on the commencement of their works, are aware of the extent of ground required for the accommodation and cover of their locomotive engines, for their cars, work shops, wood, station houses, etc. The consequence is, in the outset, the directors secure but partial accommodations, and afterwards they have to pay extravagant prices when their power by the charter to take land for the purposes of the road, (by appraisement,) is exhausted by non user. They are then completely at the tender mercies of individuals, who are generally as heartless as the corporation they have to deal with, and any advantages that can be taken of a "soulless company," is considered fair, although the construction of the road, is the main value given to their property.

We are led to these remarks from reading the first and last report of the directors of the Camden and Amboy railroad, giving an account of the requisite number of buildings and the square area, of ground they occupy for the same. It takes six pages of the report to give a list of the several buildings requisite to operate a road that is only 92 miles in length, with a freighting business in its infancy; in fact, they have but 17 engines, 71 passenger, and 64 freight cars, good and bad. To cover, preserve and keep in repair, this small equipment, the necessary buildings, with wood. sheds, etc., number 133, without including water stations, we find that the area of square feet occupied by the buildings, exceeds 230,000 square feet, or above five acres of ground. The *centre depot*, at Bordentown, contains 10½ acres. The number of acres occupied at the terminations of the road at Camden and at Amboy, is not stated. It is safe to estimate that upwards of 40 acres for depots are in actual use for the railway, mainly for a passenger business. If we recollect, the directors of the Baltimore and

Ohio railroad company, secured 15 acres in Baltimore at the commencement of their road—an extent of ground then considered ample, and even extravagant, by many of the stockholders. They had hardly got their road in partial operation, for the freighting business, when they were obliged to purchase five acres, at additional cost. We should be gratified to learn the number of acres occupied in the Schuylkill, Broad-street and other parts of Philadelphia, by those connected with the Columbia, the Reading, and the Baltimore railroads. If we are correctly informed, several entire squares are occupied in Broad-street, by the railroad forwarders connected with the three railroads leading from Philadelphia, to Reading and Pottsville, to Columbia, and to Wilmington and Baltimore.

The item of *real estate* and for *land damages!!!* on the Camden and Amboy railroad, is $371,769, or equal to $4041 per mile, for *right of way*, depots, and necessary grounds. This ratio, for a double track, is much within the cost of several eastern and other railways. We have not the report of the Stonington railroad to refer to; we believe it was some $6500 per mile. On the Long Island railroad they paid on the average, including the Jamaica railroad, at the rate of $7000 per mile, with but partial accommodations for depots. The Utica and Schenectady railroad Co. paid $5000 per mile, this ratio included the purchase of the Mohawk turnpike. The Syracuse and Auburn, paid $3000 per mile., or $375 per acre for land not worth $35 The New Haven and Hartford paid, near $7000, where there was a perfect choice of route, the land would have been given, if the error of premature location had not taken place. The Hudson and Berkshire cost $2000. The Western railroad Co. of Massachusetts, over the mountains and rocks of Berkshire, have paid at the average rate of $1700 per mile, or above $200 per acre. The general average width of railroads is 4 rods or about eight acres to the mile. From Tappan, over the hills towards Goshen, it is understood that the New York and Erie railroad Co. have allowed the proprietors, on an average, $2000 per mile, exclusive of depot, for land not worth one tenth this ratio.

We are led to present this subject for consideration, with the remark, that no prudent company should commence their work until they have secured the land on which to construct their road, so far as it can be done by compromise, particularly when there is a choice of routes, to provoke competition for the favor of the location.

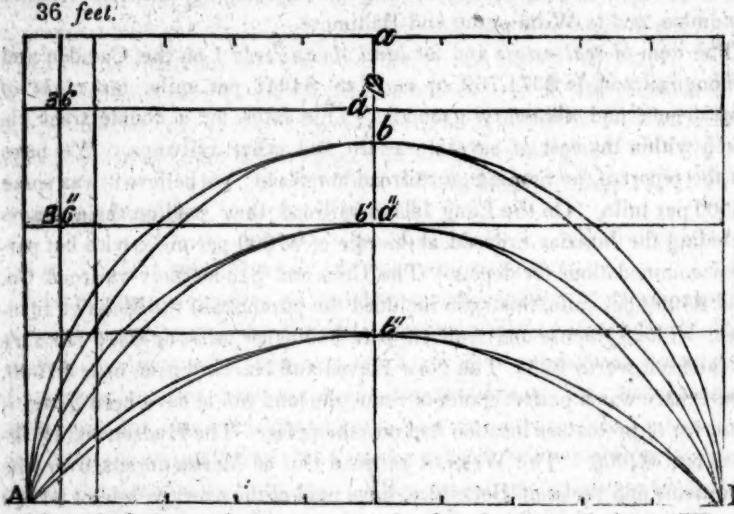
It would be highly useful if the different railroad companies, who have completed railways, and got them in operation, would furnish the Railroad Journal, for record, the amount of ground they have appropriated for their several roads, to wit: for depots—for the width of the road bed—the general cost per acre, or per mile,—the circumstances under which the ground was obtained—if by compromise—purchase—or by legal appraisement—if before or after the work was commenced, with general information on this interesting subject.

We desire to call attention to this part of railroad construction, as we be-

lieve there cannot be a railroad located in any direction without benefiting the land owners on and near its line; yet when a road is definitively located and the requisite ground not obtained, for the road bed, and for depots, relying on promises, it is then suddenly discovered by the land holder, that the railroad is a great damage to him, and he must be paid an extravagant price, or he will delay the work and contractors, so as to produce an item of damage to the company and compell them to compromise, at extravagant rates.

J. E. B.

ARCH OF EQUILIBRATION.



I have had the curiosity to ascertain the elements of three different arches of equilibration, and the same are represented by the accompanying diagram. They are all of the same span and extrade however, and differ only in elevation. The extrade is 12 feet above the crown, and level upon the top; the span is 20 feet. A b B is a semicircle, and within it is the arch of equilibration; and at 36 the distance to the curve of this arch is 42 feet, while to the semicircle it is only 35 feet, so that the last mentioned arch is loaded with only 5 in that place where it ought to be loaded with 6; and one in six you will admit, I presume, is no small proportion in any case.

Again.—Place one point of the compass below C and sweep the circular arch A b' B so that C b' will be 32 feet and within this last mentioned arch draw the one A b' B of equilibration, and from 36 to its curve will be about 27 feet, while to the circular arch of the same elevation the distance will be only about 32½, making a difference of about one in nine; that is, the circular arch is loaded at the point in question with only 8 when it ought to be loaded with 9.

Again.—Place one foot of the dividers further down and sweep the circular arch A b'' B with in elevation C b'' of 20 feet, and within this draw

the arch A b″ B of equilibration, and you will find the distance from 36″ to this last mentioned curve to be 29, while to the circular one of the same elevation, it will be only 37½, so that the circular arch will be loaded at the point in question with 16 in this case, when it ought to be loaded with 17.

Again.—Upon this common base A B=80 draw an ellipse whose semi-conjugate is 20 feet; and at the point in question its curve will rise above the circular arch A b‴ B; so that when the arch of equilibration is loaded there with 5, this elliptic one will be loaded with only 4; and about the same may be said of the cycloid. From this it appears that for the extrade here supposed the elliptic arch would require 20 per cent more weight upon its hances than it would have; the semicircle about 17, the arch whose chord is 80 and versed sine 32, about 11, and the arch whose chord is 80 and versed sine 20, about 6 per cent, so that the less the number of degrees which the circular arch contains, the nearer it approaches the one of equilibration.

Hutton seems to have spoken without due reflection when he said the elliptic or cycloidal arch was better than the circular one. It may be so in some cases but not so here.

DEFINITION OF THE SCIENCES.

Knowledge consists in understanding the relations which things bear to each other; and the word *thing* as used in the English language is as general as any word can be in any language. The word *relation* also, is very general and implies a resemblance. There are many points of resemblance, or many relations betwixt one man and another, though it is difficult to point out any one betwixt a pound of water and the diameter of the sun; and when we say we perceive *no* relation in such a case we know what is to be known respecting it, and it should not be here forgotten that it is quite as important, many times, to know that a thing does not exist as it is to know that one does so. In knowledge, and the same may be said of nature, there are three grand departments, *mathematics*, *physics* and *ethics*, and in mathematics there are three sub departments; *number*, *quantity*, and *magnitude*, and in each of these, our whole business essentially is, to *notate*, *add*, and *subtract*; and the relations here sought are those of *number*, *form*, and *size*.

The science of *number*, which is the subject of arithmetic, *calculates* that of *quantity*, which is the subject of algebra including the calcule, *compares*, and that of *magnitude*, which is called geometry, and might be more properly denominated megometry *measures*. In this latter case we always have, or imagine, a diagram to represent some definite object or form; but in abstract quantity the subject of algebra, the idea of form is not included.

Physics, treats of *matter* as we find it including all the laws by which it is governed; for matter without some inherent law or property is no matter at all, and still, to define it to our own satisfaction, we find to be no easy task. It is this that we shall say, the different parts and kinds of which

affects each other; or it is that which affects our senses; and we have two kinds of it. Of the one, the particles tend towards each other, and are consequently said to be ponderable; of the other they repel each other, and are therefore said to be *imponderable*; and generally the latter is found to have an affinity for the former, and seems to be the cause of all its motion.

In *physics* there are three grand departments: *mechanics*, *chemistry* and *planetology*, and it is not the quack doctor, but one who is versed in physics who is the proper physician.

Mechanics treats of the modifications and dispositions of matter, and consists of three grand departments—*dynamics*, *design* and *handicraft*, and the latter is only the executable part of it.

Design embraces that portion of mechanics which depends much upon taste, and its object is to invent and to plan out what is to be done. Such a plan is called projection, and is *perspective isometric* or *isometricoperspection*; and either of these may be—1st. *Oblique*, when the spectator is supposed to be fixed in position, and viewing every point but one of the object in an oblique manner, and 2d. *Direct* or orthographic, when the eye is supposed to be directly in front of every point at which it is looking. Under this latter head of *direct perspective*, comes all maps, charts, and profiles, and also the representations which are commonly made of the polar regions of the earth. Under the *oblique perspective*, we have not only common perspective, but the *spheric obliqne* or the stereographic; the same being that by which spherical surfaces are generally represented. The eye is here supposed to be at some point in the equatoral circle.

Dynamics treats of the powers of matter, and as the latter exhibits three forms we have *stereodynamics, hydrodynamics and aerodynamics*, and in each of these we have *attraction, repulsion* and *cohesion.*

Chemistry treats of the affiinit;es which different substances have for each other; ,and in ascertaining these affinities, it is generally necessary to take into consideration the *weight, composition* and *texture* ofthe substances themselves; and thence we are naturally led to inquire their *use, location* and relative *quantity*; and it may be added that we have the chemistry of nature in *animals, vegetals,* and *minerals*; the chemistry of the *chemist* in his labratory, and the chemistry of the cook in the kitchen, for even bread is an homogenous or a chemical compound of flour, water and yeast. As to *planetology*, it must be remembered, that dynamics teaches us that every particle of ponderable matter, of whatever size, in the universe, which is neither constructively, as in case of the meteor, nor actually, in contact with some other one, must be in a globate form, and moving either in a plane orbit, or back and forth in various directions around some point, and rotating also upon one of its own axes, and it is the knowledge or description of these bodies, which dynamics thus finds and leaves whether in the form of suns, stars, proper planets, or comets, that we call planatology, and here we have *three* grand departments:—1st. their physical graphy or *planetography.* 2d. The *arrangement* which their matter assumes; and 3d.

Of which we expect never to know much, their *original* and *ultimate destination.*

Speaking of the sun, we should have *heliology*, and under it *heliography*, etc., of which we already know something. Of the moon we should have *selenology*, and under it *plenography*, etc., of which we also know a little. Of the earth we have *geology*, and under it *geography*, etc., of which we know considerable, and under the arrangement of matter here, we have *bionology*, *mineralogy* and *oryclology* or *endageology*, and *bionology*, we have *zoology*, *botany* and *byomycetology*, and the nature of biorick forms fall under the head of *oryconology*.

Ethics treats of the laws by which any thing whatever is governed, and these laws consists of *self-preservation*, *security* and *aggrandizement*, and the manner in which they act is called *phrenology*. In all cases except that of man, they are said to be natural, while in his case they are said to be moral; and it must be remembered that one aggrandizes himself by good actions, and belitters himself by those that are bad.

ON THE STEAM ENGINE.

(Continued from page 181.)

The business of a civil engineer has been defined, "the useful application of the exact sciences to the common purposes of life." The successful fulfillment of his duties, then, depends on two distinct conditions:—

1. The engineer must understand the exact sciences relating to the business he undertakes.
2. The sciences to be applied must be exact.

Now, as the last of these conditions has never been attained on this subject, the former is impossible. Hence the obscurity of this branch of science, and the contradictory opinions thereon, frequently amounting to infatuation. As our object in these papers is to be truly and practically useful to society, our endeavors will extend to the substitution of plain facts and substantial truths for the uncertain theories and certain errors hitherto prevailing. Thus by clearing the mind from what is mistaken, removing obscurity by intelligible statements alone, we may hope to secure that desirable object—the speedy and universal improvement of the steam engine.

Hence, there arise two especial reasons for treating this subject much at length and very minutely; and these reasons must supply a sufficient excuse, if any be necessary, for our seeming prolixity.

The first and principal reason is derived from the immense and increasing importance of the subject to mankind. Its present certain and numerous imperfections are proved by its contradictions, and hence its probable improvement, from a full, careful and unprejudiced review of its theoretical and actual constitution, may be expected.

The second reason is derived from the consideration, that to be really useful, we must convince the most prejudiced of readers, and the most heterogeneous and opposite characters imaginable. The theoretical and non-practical or *learned* class, par excellence, including the writers at the head of this article, who expounding and misexpounding many things unheeded by practical men, confuse the latter, and thence assume infallibility; while the practical classes, whose opinions have been created and fortified by years of experience, have become equally prejudiced in favor of some peculiar and isolated practice, and as impatient of contradiction as theorists: it is thus improvement is hindered and errors perpetuated.

To correct or uproot these errors, to obtain increased and to extend real information, we must patiently compare the opposite theories together, and both, with reason. To obtain better results, let us compare the opposite practical opinions with each other, and all with experiment.

Provide a leaden boiler 4 or 5 inches diameter, and 12 inches deep, nearly filled with dilute sulphuric acid, diluted till it just boils at 320°; then take a stout barometer tube; seal one end, and bend 6 inches of the sealed end and graduating it into twelve equal parts, fill the graduated end with mercury, and also 1 inch of the longer end of the tube; then pass a drop of water through the mercury to the sealed end of the tube.

Now, suspending the tube at a convenient height, and inserting its lower end into the dilute acid by elevating the boiler, apply heat, so as to cause the acid to simmer, and maintain a constant temperature, when the drop of water, expanding into steam, will expel the mercury from the sealed end of the tube, and also all the water except a small portion thereof, which, converted into steam, remains in and occupies the graduated end of the tube, compressed by 7 inches mercury, and also by atmospheric pressure equal to thirty inches mercury. The steam then remaining in the tube is of just sufficient force or elasticity to balance 37 inches mercury, and in just sufficient volume to fill the graduated tube.

Connecting other barometer tubes to the longer end of the sealed tube, and adding successively such additional columns of mercury as may be each equal to 37 inches when measured from the lower compressed surface of steam, while the acid bath is maintained at a constant temperature, we shall find on adding one column of 37 inches, we double the pressure on the steam, and reduce its volume just one half; on adding another column, we treble the pressure and reduce the volume of steam to one third; on adding another column, we quadruple the pressure, and reduce the column of steam one fourth.

We shall find also, by removing the boiler for an instant to permit inspection of the graduated tube, that on removing or repeating these pressures, a constant and exact corresponding increase or decrease of the volume of steam is perceptible.

Hence, then, we experimentally ascertain within a heated cylinder, *the volume of steam to be proportional to the pressure*, and that the opposite opinions of Messrs. Renwick and Palmer are alike unfounded. Now, the condition of expanding steam in a heated steam engine cylinder, (which, steadily at work and amply supplied with steam, is necessarily as hot as the hottest or unexpanded steam therein,) must be fairly assumed to be correctly though minutely represented by the condition of the steam within the aforesaid graduated tube, maintained at a constant temperature; wherein it is evident no heat or power was latent or lost, or could be so, during the expansion of the steam from a small to a larger volume; but the steam, on the contrary, always retained its full and proper quantity of heat, and a power proportioned to its volume, exhibiting a gradually decreasing force consequent on expanding a definite quantity of elastic fluid into a larger space, but which expansion or enlargement is utterly inconsistent with any actual or observed loss of heat or of power; because, as we well know, the steam may be restored at will, by contraction into its former volume, heat and elasticity, by renewed compression alone, as shown in our experiment.

How idle, then, are the arguments and apprehensions that heat becomes latent, or that power is lost on the expansion of steam, which in an engine is merely a particular application—an advantageous and scientific expenditure of power! How unfounded, then, are the theories of the writers at the

head of these papers! How much plainer, simpler and better are facts than speculations, however ostentatious!

It has been determined by chemists, that the "bulk of all elastic fluids or gasses are ever inversely as the pressure to which they are subjected, while the temperature remains constant; and this property and condition of the gasses corresponds exactly with the condition of steam as detailed in our experiment; for, as we have previously shown, steam within a heated cylinder never becomes latent; it remains subject to the same laws, and has the same elastic force under pressure as the gasses—all which is apparent enough, and has been and can be easily proved by our experiment.

It really seems no easy task to decide whether the science of the non-practical classes most *promotes* or *retards* the general improvement of the steam engine, (in which so much more has been effected by the persevering, practical Cornish engineers, than by all others;) so many unfounded assumptions having been made by learned men, from which they always pretend to prove without doubt or contradiction (as in Mr. Palmer's case) that one of the most valuable properties of steam with which we are acquainted—its expansive force—is *valueless and useless.* For Mr. Palmer, basing his arguments upon *his* science, reiterates (ad nauseam) what the British engineers credit and sanction, and what every learned man expounds with woderful solemnity—that the joint sum of the latent or insensible heat in steam, and the sensible heat therein, is an invariable quantity; now, as we have incontesbtily proved there is *no heat latent in steam*, it necessarily follows, however sanctioned or solemnly propounded, that all deductions from these assumptions are visionary, deceitful, and infinitely worse than useless.

That heat in steam of every density is an invariable quantity, is as indubitably shown by our experiment as confirmed by those learned but mistaken opinions of its quality; but just as much as nature is more simple and correct in her arrangements than philosophers in their sophisms, so are the facts more simple, convincing and elegant, that the heat in steam of every density is ever active, and invariable in quantity, and the volume and temperature thereof ever exactly proportioned to its elasticity; and thus, by analysis, steam is proved to be a more simple elementary compound, and a more regular, powerful and valuable agent, than philosophers have contemplated in their misconceptions of its nature.

What singular and different results arise from the mistakes of practical engineers, or of theorists! Should the former omit any thing essential in his construction, or admit any thing unessetial therein, he must supply the one or remove the other before his machinery will act.

How different the conduct of the non-practical theorist! How tenacious of opinion once formed! How proudly does he disdain to add or diminish an iota from his solemn dictum! How incomprehensible (as Mr. Palmer has it) is any fact, however authentic or notorious, that contradicts the long cherished, and therefore unquestionable inspirations of theorists! For instance—what is more familiar, accredited, or appealed to by theorists, than the thermometer, (*anglice*, heat measure) and what can be more loose, trifling or erroneous than attaching such a name to such an instrument? Were it called an indicator of heat, as it only ought to have been, instead of a measurer of heat, unnumbered errors, arising from the mistaken notions of steam, incalculable losses, extreme miseries, and national disgraces, resulting from this misapprehension alone, would have been spared to society.

The distilling apparatus in our former paper is evidently a true and certain measure of heat, for as it invariably separates from steam of any

and of every density, the same exact quantity of heat from the same corresponding quantity of water, no possible doubt can be entertained of the correctness of its indications: hence, then, this distilling apparatus is truly entitled to the expressive and comprehensive term, "thermometer." Now, if it is so rightly entitled, by what name should the present mercurial instrument be distinguished? for by comparing its performance with its name, by testing it with the *true thermometer*, we find it the most unaccountably variable and inconstant instrument imaginable; for, compared with a true instrument, within the range of fifty atmospheres, its measure of the same quantity of heat is ever varying in the amazing disproportions of 1 to 180. How erroneous, then, this name! How deceitful and dangerous this application of the term to such an instrument—an instrument of perpetual reference in the most delicate and important experiments that science can devise!

This complicated and deceptive action of the mercurial thermometer evidently depends on the different rates of expansion by heat between mercury and glass. In Turner's Chemistry, it is stated that mercury and all fluids expand in volume with an increasing ratio at increasing temperatures; and that glass, having the same tendency to increase more in volume with increasing temperature, and having nearly the same increasing ratio as mercury between 32 and 212°, the correct action of the thermometer remains nearly unaffected thereby. How different this (if it be so) from the higher temperatures we have quoted, where the capacity of the glass bulb must either have increased faster than the volume of mercury in the ratio of 180 to 1, or both have been proportionally affected in some intermediate but equivalent degree!

As the physical cause for this great anomaly is unknown, it seems singular it has been hitherto so disregarded, as it is evidently a curious subject, well deserving the notice of any institution aspiring to the term scientific; we cannot refrain from commending it to the notice and attention of our friends of the Mechanics' Institute of New York, for elucidation.

Improper as is the name, and misleading as has been the nature of the mercurial thermometer, yet in skilful hands, with the aid of Ure's or of Dalton's tables of elasticities and temperatures of steam, it affords a ready means of ascertaining the internal state and power of a working engine, by applying it to the various parts thereof; and in this way may many matters now unknown or disputed, be quickly, quietly, and satisfactorily disposed of, or become plainly exhibited.

As one example of the utility of this ready mode of acquiring information, we will test by a thermometer the actual value of a recently patented improvement of the steam engine, of great celebrity and greater promise, being the invention of one of the leading members of the British society of civil engineers, who is at the head of one of the largest steam engine factories in Lonnon, where of course every facility may be supposed to exist for testing the value of any improvement previous to submitting it to public notice or animadversion.

Thus, the Messrs. Seaward propose heating the water in its passage from the hot well of the engine to the boiler 60°, by the steam in its exit from the cylinder to the condenser, expecting and promising a saving of no less than ¼th of the fuel thereby; and all this they propose effecting by causing the water to travel through thin copper tubes inclosed within the eduction pipes of the engine; now, the simple application of a thermometer to those pipes will in a few minutes show their temperature to be but little if any in excess of the temperature of the hot well, from which the water is fed to the boiler; and hence we see the water cannot be heated a single degree by this therefore useless contrivance, unless some improper, say wire-

drawn, interruption of the steam in its passage from the cylinder to the condenser be interposed, which would be so prejudicial to the power of the engine, that to suppose it to be practiced by any honest engineer is impossible.

How easily might all this have been fore-known, from the fact now so apparent, as every part of the eduction pipe is alike a part of the vacuum, so called; and as every part of this vacuum is alike occupied by and alike warmed by steam of a corresponding elasticity and temperature, so no part thereof can be hotter than another.

The same discovery was patented by another ingenious mechanic, Mr. Hase, of Saxthorpe, Norfolk, England, and applied to an engine for the Norwich flour company, forty years ago; and Mr. Hase promised the same advantages, and expected of course the same profit then as the Messrs. Seaward are now anticipating. Surely the lawyers who contrived, and so kindly, the dear English patent laws for the great encouragement of genius, as they have it, can alone discover that genius is certainly rewarded.

We have observed a thermometer attached to the eduction pipe of a Watt's pumping engine to stand at 90°, and not to differ a degree from the temperature of the hot well; and we have as often seen the same engine continue steadily at work for some time, with the safety valves of the boilers thrown open, and with the small greasing-cock in the cylinder-cover unclosed, and consequently admitting a constant, small current of air to enter the steam engine cylinder. Thus the engine was working with steam of considerably less elasticity than atmospheric (which elasticity might have been easily ascertained from the tables by the aid of the mercurial thermometer); hence the estimates of Professor Renwick, however he obtained them, are very erroneous, viz. that pumping engines, loaded as they are with 10 lbs. per inch, require a steam pressure of 17½ lbs. which we see they do not; and as the difference between the fact and the Professor's statement is so very considerable, this his calculation of the useful effect of low pressure steam is very much underrated, and only calculated to mislead in a matter of great import.

Again, the professor as extravagantly overrates the value of high steam as any of the earlier and wildest projectors, by stating (p. 22) "the general law of the expansive force of steam is that while the heat increases in an arithmetical ratio, the expansive energy increases in a geometrical progression." And at p. 23, gives an exact measure thereof, the tables of Dulong and Arago, calculated to fifty atmospheres. Our experiments have shown these imaginary laws of heat in steam to be vain dreams, and only innoxious now, because fully exposed.

Having published these tables, accompanied by such plain and unreserved statements as above, it could have been only expected they were intended by the professor as guides to practice; for if they were not so intended, they would most probably be, as they ever have been, very pernicious. But so far as we can discover, the professor does not mean any such thing; nor are we able to ascertain with any precision what he does mean, having left this essential matter quite undecided; and making very different assertions in different parts of his treatise, which assuredly is a strange way of treating a subject requiring mathematical accuracy and precision above all things.

What a contrast does the following quotation present to that just quoted from p. 22! At p. 162 he says:—"The density of steam increases nearly as fast as the pressure under which it is generated; did both increase in the same ratio there would be nothing gained by the use of high steam."

Although the professor is vastly nearer right in p. 162 than at p. 22, the

latter law absolutely contradicting the former law, yet our experiments prove him still incorrect and mistaken considerably, as the density of steam is always exactly proportioned to and increases fully as fast as the pressure; and therefore nothing is or can be gained by the use of high steam as such; which is amply though unintentionally certified by the professor.

We have seen that professor Renwick not only doubts, but completely contradicts himself on these very important and most essential matters. Not so Mr. Palmer, who states his opinions not only without doubt, but terms his every assertion, however astounding, an established law of nature. Some of these we quote in detail, lest it should appear incredible that they were ever admitted into a scientific journal. At p. 182, he says:—"I care not whether the steam applied as motive power be what is termed atmospheric, or high pressure; whether it be worked expansively, or otherwise; whether condensed or blown into the atmosphere; whether the engine be of the denomination technically termed single, double, or atmospheric; or, in fact, whether the steam be applied to any other apparatus human ingenuity can devise, even in the absence of all friction."

What quixotic conceit, what indistinct notions, what confused ideas these, for a sober, philosophical civil engineer!

Again, from the same page: "From the aforesaid data I will show that nature herself cannot produce a result (in the absence of all friction, as before premised) amounting to one half of what is stated to be the duty of some of the Cornish engines."

What a delicate appreciation of the credibility of the disinterested Cornish reporters; and what a happy and instructive comparison between the artificial performance of a steam engine and the unartificial efforts of nature!

Again, from page 183: "Having stated the maximum effect that nature is capable of accomplishing, 44,467,500 lbs. water raised one foot high with one bushel best Newcastle coals, and having shown the maximum effect that can be accomplished by the atmospheric steam generated by a bushel of coals my next object will be to demonstrate that high pressure steam, when applied expansively, cannot produce so great an effect as atmospheric steam."

Whoever reads the above quotations, that is capable by education and practice of forming a just opinion thereof, must perceive Mr. Palmer, however otherwise informed, is profoundly ignorant of the subject he has so hardily and so unluckily attempted. In proof of this our assertion, he says, he "cares not whether the steam is expanded or not." Now, as the expansion of steam, doubtless, greatly adds to its useful effect, as we will hereafter show, in crank engines, (Prof. Renwick has stated five times) it is evident to every one well informed on the subject that Mr. Palmer could not have understood the nature or value of the elastic force of steam, which property is in itself as simple and easy of comprehension as the power evolved during the unbending of the main-spring of a watch.

That any individual engineer could be found at this period, so apparently learned or even plausible, yet so really ignorant of his selected subject, would be incredible on any evidence but his own; or that such vague and confused ideas should be sanctioned by any society of practical men, or that such unfounded and dishonorable detractions from the Cornish engineers should be allowed by their countrymen and fellows, the London Society of Civil engineers, could never be credited, did they not appear in their own publication.

Let it then ever be remembered how much the successful industry of the Cornish men have added to the wealth of their nation, and how much their successful ingenuity has increased its engineering character, by showing

the greatest improvements of the steam engine, which the London engineers have neither had the sagacity to appreciate or imitate, the liberality to praise, or the prudence to avoid disparaging, while all other engineers behold them with unbounded admiration.

We shall satisfactorily conclude the present paper, and this portion of the subject, by another quotation from Mr. Palmer and the few and necessary observations thereon.

"If the statements given to the public by the Cornish engineers are correct, I dare not trust myself to call nature to account for the undue favoritism she confers upon our Cornish friends, by enabling them to obtain results in Cornwall that the London, Manchester and Birmingham engineers cannot approach; and I shall perhaps be excused from expressing my surprise that the question has not long ago been set at rest, by some one erecting in London or elsewhere an engine capable of raising 70,000,000 lbs. (I will not ask so great a favor as 120,000,000 lbs.) of water, one foot high, by the consumption of one bushel of coals. Let this only be done, and I shall be the first to hail the result as one of the greatest achievements of man over matter, and give the Cornish engineers that meed of praise they would so richly deserve for the benefits conferred on science, or upon the manufactures and commerce at large."

Now in a late number of the Engineer's Journal, it appears a Cornish pumping engine has been erected at the East London water works, that has lifted 72,000,000 lbs. of water a foot high, by the consumption of a bushel of coals, besides the friction of the engine and machinery. This would seem to show that there was very little cause for or reason in Mr. Palmer's exquisite work, in which he has exhibited nothing creditable to himself or to the institution of the civil engineers, or useful to mankind.

As we have endeavored, so we trust to have fully relieved him from all future trouble of making established laws for nature; and as his relief must thus be very considerable, we hope his gratitude will be proportional.—*American Repertory.*

SOUTHERN RAILROADS.

Mr. Chase,—I hand you herewith an extract from a very able article in the New York Review, for April, 1840, on "improvements by railroads and canals." The particular object I have is to show the preference given by the writer, to the great line improvement, of which the Georgia railroad forms a part. He copies and endorses the classification made by Monsieur Chevalier, of the public works of the United States, in these words:

"In the United States great public works must have for their objects

First. To bind the shores of the Atlantic with the country west of the Allegany; that is to say, to connect rivers, such as the Hudson, the Susquehannah, the Potomac, the James river, or bays, such as the Delaware or the Chesapeake, either with the Mississippi, or its tributary, the Ohio, or with the St. Lawrence, or the great lakes Erie and Onotario, whose waters are conveyed by the St. Lawrence into the sea.

Second. To establish communications between the valley of the Mississippi and that of the St. Lawrence, that is to say, between one of the great tributaries of the Mississippi, such as the Ohio, the Illinois, or the Wabash and lake Erie, or lake Michigan, which lakes of all those which have an outlet by the St. Lawrence, extend furthest south.

Third. To connect the north and south poles of the Union, New York and New Orleans.

Independently of these great systems of public works, which are in pro-

gress of construction, and even in part executed, there exist secondary groups of lines of transportation, having for objects either to facilitate the access to centres of consumption, or to open outlets to certain centres of production. The first of this class of cases embraces different works, canals or railroads, which leave the great cities as centres, and radiate in different directions around them. The second comprises such works as have been executed to bring into market different coal fields."

After speaking of the first and second classes of public works, as affording little or no inducements for the investment of private capital; indeed the writer goes so far to say that, "to individuals, such investments, to any great extent, would prove certain bankruptcy and ruin," he proceeds to say in reference to the third class:—

"There is no such uncertainty as to the third line of communication mentioned by Mr. Chevalier, that between New York and New Orleans. Connecting, as this does, the metropolis of the union with the great Atlantic cities of the northern and the capitals of the southern States, this line of communications has at the same time the advantages of forming the most direct line between the eastern and southern States, and of traversing a belt of country which presents for the execution of a line of railroads, peculiar facilities. The public has evinced its perception of the advantages of this great line of thoroughfare, by the large amount which has been contributed within the last six or eight years, almost entirely from individual resources, to its execution. The separate links which have been so far made, bid fair, even should it not be extended beyond its present terminus in the south, to be extremely profitable; but there is scarcely a doubt, that within six or eight years more the whole chain of communication will be completed to New Orleans, and that there will then be a travel and trade over every portion of it, beyond any present conception of its extent.

At the time of the publication of the sketch of Mr. Chevalier, detached links only in this chain of communication had been made as far as the Roanoke, in North Carolina. Within the two years which have since elapsed, the Philadelphia and Baltimore, the Richmond and Fredericksburg, and Richmond and Petersburg railroads, have been put in operation; and south of the Roanoke, lines of railroad have been completed to Wilmington in North Carolina, at the mouth of the Cape Fear, and to Raleigh, the capital of the State on the more direct route to Columbia and Augusta. Between Columbia and Branchville, on the line of railroad which connects Charleston and Augusta, a railroad is now in progress of construction, which it is understood, will be completed in the course of the present, or early the coming year, leaving only the distance between Raleigh and Columbia (about two hundred miles, but which is said to be of extremely easy execution,) to be constructed, to furnish a complete railroad communication between New York and Charleston and Augusta. Between Augusta and Montgomery, on the Alabama river, whence to New Orleans there is for about two thirds of the year an excellent steamboat communication, railroads now in progress of execution will probably be finished by the time the line north of Augusta is in readiness.

Great profits may undoubtedly be anticipated in every portion of this great chain of communication, when executed with tolerable judgment and under favorable charters. In another point of view, however it is much more interesting to us. No line of improvement which has been projected in America, and perhaps none which can ever be made, is so important in a political as well as a commercial aspect, as the one we have been contemplating. In the time of war, the government will be enabled by it, with a moderate standing army, to provide for the defence of its whole Atlantic

coast, an object not to be attained effectually without it by the whole force of the country. It will furnish in such a contingency, the means not only of transporting men and munitions of war, but in the event of the blockade of the coast, of exchanging the staples of the south and manufactures of the north and east. In the estimation of the patriot, devoted above all things to the preservation of the Union, this connexion, between what Mr. Chevalier terms *its two poles*, has yet a higher value. "When," he remarks, "New York shall be only six or eight days journey from New Orleans, not only for a rich class travelling in a privilege manner, but for every shop keeper and every workman, separation will no longer be possible. Great distances will have disappeared, and this Colosus, ten times vaster than France, will maintain its unity without effort.

It is among the many fortunate circumstances of our country, that its most essential line of improvement offers such strong inducements to its speedy execution, both in prospects of profit presented by it as an investment, and its other advantages. In other countries, the works essential to their defence and protection have been executed usually at great cost, and with heavy burdens on the subject. With us, the one which is to make us impregnable in war, and to unite us indissolubly in war and peace, is, at the same time, to add largely to the wealth of the nation, and of the shareholders of the companies co-operating in its execution."—*Southern Banner.*

NECKAR.

REPORT ON MR. L. PHELEGER'S SPARK ARRESTER.

The committee on science and the arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination an apparatus for arresting sparks issuing from the flues of locomotive engines, invented by Mr. L. Pheleger, of Philadelphia, Penn., Report:—

That they have examined this apparatus, and witnessed its operation on some of the engines of the Philadelphia and Baltimore railroad, where it has been on trial for several weeks.

It consists of several parts, the arrangement of which will be described with as much detail as is essential to the object of this report. Around the smoke-pipe of the engine which is of the usual form and dimensions, is placed a case of sheet iron perforated with some thousands of small holes, resembling those of a fine nutmeg grater with the burr turned inwards. This case is sufficiently large to leave a space of two inches width between it and the smoke-pipe, and rises several inches above the top of the pipe; it is closed at the top by an inverted conical cap of thin cast iron, which is fixed on a hinge and furnished with a lever and rod, by which it may be raised out of the way when the fire is first kindled, for getting up steam. Outside of the perforated case just described is a second casting of sheet-iron, not perforated, but furnished with twelve out-let pipes about six inches diameter, six of which pass out at its base, and after two bends, or elbows, are again inserted at its top: the other six are similarly inserted at the top of the outer case, but have their lower insertion within about 12 or 15 inches of the top.

The annular chamber between the two cases, is open at the top for the ultimate escape of the smoke and vapour.

When the smoke and cinders are thrown up the smoke-pipe by the power of the exhaust, they strike against the conical cap which closes the top of the perforated case, and rebound into the annular space between it and the enclosed pipe, with great velocity. The smoke and other gasses from their small momentum, soon lose a part of their downward motion and are

forced out through the numerous perforations, which present an aggregate area of passage much greater than the section of the smoke-pipe, and thus give free vent to the gases. The cinders having a greater density are carried downward by the joint effect of their momentum and gravity, until they are beyond the effect of the exhaust, and are finally shaken by the motion of the engine into an iron receptacle connected with the annular space in which they have been deposited.

The smoke and steam, with some of the fine particles of dust, having passed through the perforated case, enter the annular chamber between the two cases, and are mostly carried to the bottom of this by the portion of their directive force which they retain. From this they escape by the six longer out-let pipes described as proceeding from the base of the chamber and are given out at the top of the chimney; the small sparks, if any escaped through the perforated case having been extinguished, or deposited in the circuitous course through which they must travel.

This circumstantial statement of the action of the apparatus is given, because at first view of it, not much confidence was placed in the probable result; but repeated trials having proved its complete efficiency, it was deemed worth while to examine minutely into the mode of its operation, and give a brief description of it in this report.

The trials in the presence of the committee were made under a variety of circumstances, well calculated to remove all uncertainty of the entire correctness of their observations. On the first occasion they travelled behind the engine from Elkton to Gray's Ferry, a distance of 45 miles, entirely after night. On the journey down to Elkton they were conveyed by an engine provided with a spark arrester of some other form, whose it was they did not learn, but it may suffice to say of it, that the route was enlivened after night-fall, by a copious shower of brilliant cinders, which were scattered many yards to the lee side of the road, notwithstanding a heavy rain which was falling at the time.

On returning with the apparatus which is the subject of report, they were agreeably surprised to find that while the engine was running with the fire door closed, not a single spark made its appearance. When the engine was standing, or when the fire-door was opened, a few sparks were seen to escape, but the number was so small as to be easily counted, and they were so light that they were extinguished, or burned out before passing half across she road. A subsequent trial was made in the presence of some members of the committee, when both engines, going and returning, were furnished with this apparatus, so as to give an opportunity of witnessing its effect by day and by night; the result on this occasion was equally satisfactory as on the former.

As the committee have had some experience of the operation of spark arresters, and have generally found, heretofore, that they were efficacious only in proportion as they impeded the fire draught, it was deemed important to inform themselves particularly on this point, in the present case. On enquiry of the engineers who are using the apparatus, they agreed in asserting that the engines made steam quite as well with it as without, and some of them supposed even better. The engines used on these trials were drawing their usual train on a full trip, and certainly made abundance of steam, blowing off during a considerable part of the trip; and an examination of the fire when the furnace door was opened, showed that the effect of the exhaust was not perceptibly diminished.

In conclusion, the committee feel entirely free to state their conviction, that the experiments witnessed by them were completely successful, and if farther trials made with heavy trains shall give similar results, and the ap-

paratus is not found to become impaired in its efficiency, by the choking up of the perforations, as has been the case with some others in which the perforated sheet has been used, they believe it will constitute the long-sought desideratum of an efficient machine which completely removes all danger and inconvenience from the chimney sparks, while it does not sensibly diminish the power of the engine.

By order of the committee.

WILLIAM HAMILTON, *Actuary.*

August, 13, 1840.

ADVANTAGES OF COMPRESSED PEAT. By Alexander S. Byrne.

The properties of peat have been long known to the scientific world, and it is matter of surprise that no attempt has been made at an extensive diffusion of the advantages which it possesses in a *compressed* state. These advantages are so important as to deserve and demand the greatest possible attention in every country where peat abounds. What is more interesting than to give employment to the industrious poor of any country? What so much so at this period as to provide constant and profitable employment for those of Ireland? Great and important as is the discovery to this country, it is so in a more especial degree to Ireland, whose bogs will be rendered as valuable as coal mines, holding out the pleasing hope that in time that unhappy country will become the seat of those arts of which cheap fuel may be said to be the parent. Such, however, would be an effect consequent upon the production and application of compressed peat.

To enumerate all the advantages of compressed peat would appear as one of the delusive hopes with which the present age has teemed: it will therefore be sufficient to explain such as are palpable, and which cannot with reason be doubted.

Peat (sometimes called turf,) consists of vegetable matter, chiefly of the moss family, partially decomposed by the action of water. The dense black turf, or lower stratum of peat bogs, is much contaminated with magnesia, sulpher, iron, earth, etc., while the upper stratum consists of almost pure vegetable matter. In its natural state it is loose, fibrous, porous and spongy, and contains generally from 30 to 80 per cent of water. The filaments are very strong and elastic; but when decomposed they yield readily to pressure, and break into disjointed pieces like small worms or threads.

From its extreme lightness, and impurity of the lower bed, turf is not generally employed as fuel, or as a useful article in arts and manufactures; but in countries where it abounds, and where coal is scarce, it is cut by the peasantry during the summer season, dried, stacked, and used for domestic purposes. There are many varieties; but in almost every region the top surface consists of pure vegetable fibre, undecomposed; and whether consolidated or not, can be beneficially employed for the production of dyes, pyroligenous acid, distillation, and many other purposes to which wood and vegetable substances are generally applied.

When compressed to the solidity of coal or wood, it can be successfully, beneficially and very profitably employed for the following purposes:

As *fuel;* for this use it is of inestimable value in steam navigation and railroad carriages, effecting in stowage alone a saving of at least one third.

For the production of gass; in which it gives birth to many improvements.

For *smelting ores;* particularly iron, copper, and lead.

For an *improved road;* superior to wood, stone or asphaltum.

For pavements, flooring, pannels, cabinet and ornamental work.

For the manufacture of *paper*, cements, pigments, *dyes*, *pyroligneous acid*, *etc.*

For lime burning, and many other similar purposes.

The cost of production, dependant of course upon localities, must still, on all occasions, be very small, from the facility with which it is worked; and looking at the price of coal, it is not too much to assume that in all districts where peat is found, it can be raised and compressed 50 per cent cheaper than any other fuel. These facts can be proved upon incontestible evidence, and exhibit one of the sources whence profits must accrue to those who are engaged in applying them.

A great obstacle in the compression of peat is the presence of water and the strength of the vegetable fibre, the resistance from which has been matter of surprise to all who have studied the subject. The superabundant moisture may be easily pressed out in almost any description of press; but this can only be continued to a given point; for when the interstices of the peat are closed up, the resisting force of the confined water and air is so great, and the possibility of their escape so effectually prevented, that the block of peat undergoing pressure becomes itself a hydraulic; and however much pressure may be afterwards applied, the confined water, aided by the strength and elasticity of the fibre, will react when the pressure is removed, and force the whole mass back again to the state when the superfluous moisture was removed. This is in fact the starting point; and those who have reached but so far in the art of compression have done very little for the removal of established difficulties.

To overcome these difficulties, many remedies might have been proposed. Mr. Charles Williams, of Dublin, proposes to break up the peat to a fine powder, until it assumes the consistance of *pap*. Thus by destroying the vegetable fibre and all resistance from that source, he presses this pulpy mass into a solid lump, either in perforated boxes or in hair cloths, as in the compression of linseed cake. I have seen some specimens of Mr. Williams's peat denser than oak, and have used coke prepared from this source with extraordinary advantage.

Lord Willoughby d'Eresby, Mr. R. C. Stewart, Dr. Geary, and several others, have successfully applied various presses, with escapes for the confined water from the centre of each block of turf undergoing pressure. Mr. White, of London, (an engineer) has succeeded in extracting a large proportion of water, and in producing an extraordinary hard peat by means of a vacuum. He covers a large perforated surface with peat, and by withdrawing the atmosphere from beneath, he forces a vacuum, extracts the water from within the turf, and obtains a very close substance for domestic and other uses. Prof. Maugham, the celebrated lecturer at the Polytechnic Institution in London is explaining this process, and applying it to many branches of manufactures with wonderful effect.

But the most simple and least expensive mode is to *evaporate* the water, and compress the peat *while warm*. By this means not only is the water dispelled, (being converted into steam) but the moisture of the inner threads is so completely rarefied, and the resisting force from the vegetable fibre so entirely destroyed, that compression to any degree of solidity becomes comparatively easy, beside which a principle of cohesion is imparted to the whole mass, which causes it to unite without any further disposition to return, as is the case before the vegetable fibre is destroyed. Upon the same principle, a *warm* blanket can be squeezed perfectly dry; a *cold* one cannot. In fact, it is a universal principle, that water in a state of steam is easily dispelled, and that bodies when warm and damp have a greater disposition to unite than in any other state.

I should therefore recommend this method in preference to any other for the compression of peat: As soon as it is cut from the bog, it should be spread upon a large table with a fire underneath, that the water may be evaporated; and while the vegetable fibr is still warm and moist, compressed in suitable presses into square blocks. The kind of press is of no consequence; but I have found a monkey or stamper press preferable, as it is very cheap, and can, from its construction, be easily removed from one spot to another.

Two men can cut and compress more than two tons per day, and the cost of necessary machinery would not exceed $100.

In the coking of compressed peat there is much for communication; and more particularly in its application to the manufacture of iron, gas, roads, etc., which will be fully explained in our next paper.

TO CHARLES WYE WILLIAMS, OF LIVERPOOL, IN THE COUNTY OF LANCASTER, *gentleman, for his invention of certain improvements in the processes or mode of purifying or preparing turpentine, rosin, pitch, tar, and other bituminous matters, whereby the power of giving out light and heat is increased, either when distilled or burnt as fuel.*

This invention consists in a peculiar mode of rendering the several bituminous matters, as turpentine, rosin, pitch, tar, &c., more effective, when used for the purpose of giving out either heat or light, by bringing such bitumens into intimate contact with atmospheric air, in order that several of the gasses with which they are charged, and in particular the combination of ammoniacal gas, known to be injurious in the processes of burning for the production of light or heat. In order to afford the best information for carrying my said invention into effect, I give the following description of the process of means which I employ, namely:—I place the bitumen to be purified in a large pan, or vessel, over a fire,—and when raised to near the boiling point, I cause a second vessel, shaped and pierced with numerous holes, like a colander, to descend into the former; and when filled with the melted bitumen, to be raised suddenly a few feet, to allow the melted stuff to fall through in shower-like streams, by which, in the act of dripping down and returning to the first mentioned pan, the melted material comes into extended contact with the atmosphere; the result of which is, that a large portion of the ammonia, and its combinations, and other gases, with which such bitumens are charged, are expelled or drawn off by the atmosphere.

This filtering or mixing process, by which the bitumen and atmospheric air are so brought in contact, is to be kept going on, until the material has received the required extent of purification, and which operation may be carried on as long as desired.

This process of lifting the bitumen, and allowing it to fall through the colander or other shaped vessels, pierced full of holes, may be effected by mechanical means, or simply by hand utensils.

The temperature to which the bitumen must be brought, should be about the boiling point; but varying, of course, according to the kind of bitumen operated on, and which a little practice will soon point out.

While this process is going on, I cause a strong current of atmospheric air to pass across the falling portions, drops, or streams of the bitumen, by means of a fan or other well known mechanical means,—the object being to cause a larger admixture of air with the bitumen, in the act of falling or dripping down, and by which the ammoniacal and other gasses, which are very volatile, are passed off in great quantities.

I do not intend to confine myself to bringing such bitumens to any par-

ticular temperature, or to continue this filtering or mixing process for any particular length of time; but intend to avail myself of any extent or continuance of this operation, until the air has sufficiently acted on the bitumen, with which it is thus mechanically brought into contact.

And whereas, the process of purifying the various bitumens above described, has been practised by other persons, I make no claim to purifying such materials by any other means; but I do claim that mode of purifying the same, by agitation and mechanical admixture with atmospheric air, and for the purpose of exposing extended surfaces of the bitumen to contact with atmospheric air.

NEW YORK AND ALBANY RAILROAD.—We regret to hear that no satisfactory steps are making in behalf of this great, and, to the city, important work. If any amount of stock has been taken of late, the fact has not come to our knowledge. We can hardly account for this apathy or this neglect, inasmuch as by night and by day, the workmen are pushing on with the Great Western Railroad, to connect Boston with Albany.

It seems to us that if a Railroad were established between this and Albany, on the latest improved plan, and of the best materials, such as are most of the railroads in England, that there could hardly be a doubt of a profitable result. An odinary Railroad, on which a Locomotive would average only 12 or 15 miles an hour, would hardly compete in summer with the Steamboats on the Hudson,—but a road on which the traveller could go his 40 miles per hour, reducing the distance from Albany and New-York to only four hours, would be a serious competition with the navigation of the Hudson even in summer, inasmuch as Albany could then be visited and returned from, in a single day-light, and with ease. It is very true, such a road would cost a great deal more than most of our roads per-mile, but it is not a better one than there ought to be, under such circumstances, particularly between the capitol and its great commercial city.

We remark, by the way, that the most expensive railroads in England have now become most valuable investments, some of which are built with less of promise than this we have under contemplation. On twenty lines of road, from December to July last, comparing the quotations of stock in the share list, the increase in value amounts to the enormous sum of *eight millions Sterling.* "Thus," says the Railway Times the Great Western shares in that peried have risen 52*l.* per share, namely, from 10 discount to 42 premium, equal to 1,200,000 upon the 25,000 original shares. The Loudon and Birmingham shares have in like manner risen from 50 premiun to 99 premiun—equal to 1,225,000*l* upon the 25,000 original shares. The quarter shares have risen from 22 to 36 premium, equal to 200,000*l* and the new shares have risen 13*l*, equal to 405,950*l*—making altogether upon the shares a sum of 1,830,950*l*. The shares of the other lines in the following table are computed in the same manner.

Great Western	1,925,000*l*
London and Birmingham	1,830,950
Grand Junction	829 000
London and South Western	612,000
Eastern Counties	448,000
North Midland	420,000
London and Brighton	360,000
Manchester and Birmingham	180,000
London and Croydon	165,000
Great North of England	150,000
London and Blakwall	120,000

York and North Midland		102,000
Birmingham and Gloucester		95,000
Chester and Crewe		90,000
Bristol and Exeter		90,000
Cheltenham and Great Western		75,000
Birmingham and Derby		63,000
London and Greenwich		60,000
Total improvement in value,	$38,024,720	7,604,944*l.*

NEW RAILWAY LOCOMOTIVE; INVENTED AND CONSTRUCTED BY MR. WALTER HANCOCK, OF STRATFORD, ESSEX, AND NOW ON TRIAL ON THE EASLERN COUNTIES' RAILWAY.

One of the principle advantages of this locomotive is presented in the boiler, by which steam of greater power is generated with far greater certainty of continued supply, and more perfect safety, than by the boilers now in use, either in railway, marine, or stationary engines. This boiler is constructed of a number of distinct chambers, each chamber composed of several tubes. Each chamber, or rank of tubes, connects with two general cylinders or reservoirs—one at the bottom for the supply of water, and the other at the top for the reception and passage of steam. The communications from each chamber to the water, steam, pipes or reservoirs, have self-acting valves. When any leakage occurs, from wear, rents, or other causes, to any one chamber, the valves belonging to it close, and are kept to their seats by the pressure of water and steam contained in the neighboring sound chambers, and the boiler remains as effective as before, excepting that the surface of that one chamber, is thrown out of use, without stopping the engines, and perhaps it would not be observed by the engine driver until the end of the trip, when the pressure being reduced by withdrawing the fire, the valve would fall from its seat and point out the defective chamber by the discharge of water. In half an hour a new chamber could be attached in its stead. In the ordinary locomotive boiler, when any one of its tubes become defective, the whole is rendered inoperative by reason of the unchecked communication of all the parts with each other, and so it remains until the defective tube is repaired, replaced or plugged, which generally occupies three or four hours, and is attended besides with the inconvenience of stopping the train until another engine is procured from the next station.

By adopting the improved boiler no such delay would occur, and the expense both in fuel and wages, of keeping a number of engines with their fires up ready to meet such casualties, would be avoided, as well as the risk when a train stops out of time, of having another train brought in collision with it, and the lives of passengers and attendants endangered.

The great heating surface obtained in a comparatively small space, is likewise a recommendation to this boiler. It is intended to attach a reciprocating set of fire bars to it, by which a clean floor of bars can be introduced without lowering the fire. The small weight of this boiler in comparison to its generating power, is another material point in its favor, for it leaves room for giving sufficient strength to all other parts, without exceeding the present total weight of a locomotive.

Having given a general description of the power—the engines and machinery come next under consideration.

The engines of the present locomotives are placed horizontally, and are thereby very much confined and difficult of access, but in this one they are

vertical, and therefore the whole of the machinery, pumps, etc., are open to view, can be readily oiled, and speedily detached for repairs; or any portion may be put right and secured while the engines are working.

The engines of this locomotive give motion to a separate crank shaft, and this communicates the progressive motion to the wheel axle by an endless chain, working over a pulley fixed on each, and which two pulleys may be either of equal or different diameters, so that advantage may be obtained either for speed or power whichever may be required. This arrangement not only allows the wheel axle to be straight instead of cranked, but it also possesses the advantages of a moderate accommodation or play, by which all sudden jerks or concussions of the machinery, etc., are avoided.

The friction is reduced to above one-half, from such large eccentricities, crank-bearings, etc. not being required, in consequence of the weight of the machinery, boiler, etc., being on straight instead of cranked axles.

This arrangement allows the work to be immediately thrown out, so that the engines will work the injection pumps, and get up the fire without working the driving wheels. By running locomotives about to effect these purposes, much of unnecessary wear and tear is incurred, besides running on the rails in the way of trains, etc. The present locomotive need not stir from the spot until the train is attached—the clutch then thrown in, it immediately starts upon its trip.—*Railway Times.*

AMERICAN ENTERPRISE.

We understand that the Emperor of Russia, by his agent, has closed a contract with Mr. Norris, of Philadelphia, for *two hundred locomotive engines*, forty of which are to be delivered each year, for which the Emperor is to pay $1,400,000. These engines are principally to run upon the great railroad, now in construction between St. Petersburg and Moscow.—We believe Mr. Norris had previously made a contract to furnish several engines to the Government of Austria, and our readers will recollect seeing it stated in the papers some time since, that the locomotive of Mr Norris, took a premium in England after a full and fair trial with many others.

This is another, and a most conclusive proof that the ingenuity, skill and enterprise of our countrymen, in a fair trial, is fully equal to that of any and every other people, and that whenever and wherever we come in competition with equal advantages, we shall come off victorious.

It is now the opinion of scientific men, who have looked into the matter, that there is no longer any doubt of the *complete success* of the experiment of manufacturing iron with anthracite coal, and if so, that *America must soon become the great iron market of the world*, as she will be able to furnish the article much cheaper than it can be obtained any where else. The subject of railroads is now being discussed throughout Europe. France has at least 1000 miles in contemplation, and Russia and Austria as many more; and even the government of the sublime Porte, is beginning to talk of a railroad from some of her outer ports of the kingdom to Constantinople. When we recollect that five years since, we were obliged to send to Europe for our locomotives, and that now we can manufacture them *cheaper and better*, both for ourselves and others, can we doubt that within ten years from this time, Pennsylvania will furnish to Russia, to France, and to Austria, not only her locomotives, but her *railroad iron*.

Thus then, the tide of trade will be completely turned, and instead of paying to Europe interest for money to make our railroads and canals, we shall not only be able to cancel our State debt, but receive millions of Europe in return for the iron and coal of our mountains.—*Penn. paper.*